



# ITK Strip DAQ and Tests

Alessandro Tricoli (BNL)

US ATLAS HL-LHC Strip Tracker Upgrade Project Meeting  
at Penn

11<sup>th</sup> – 12<sup>th</sup> May 2016

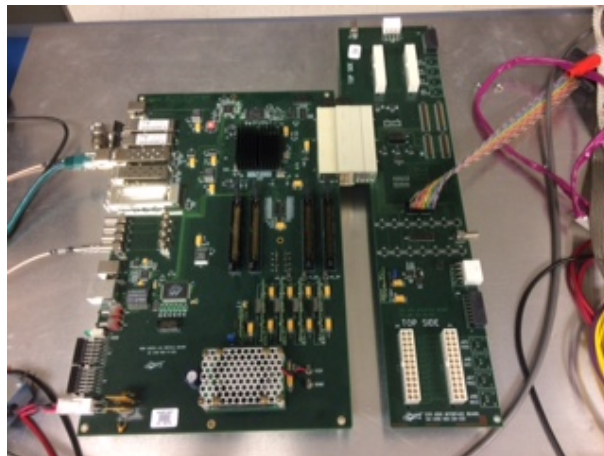
# Overview

- ❑ Readout boards: HSIO, ATLYS, NEXYS
- ❑ DAQ software status
  - Firmware/Software overview
  - Documentation
- ❑ DAQ load production and test setup at BNL
- ❑ Plans for discussion

# Readout boards

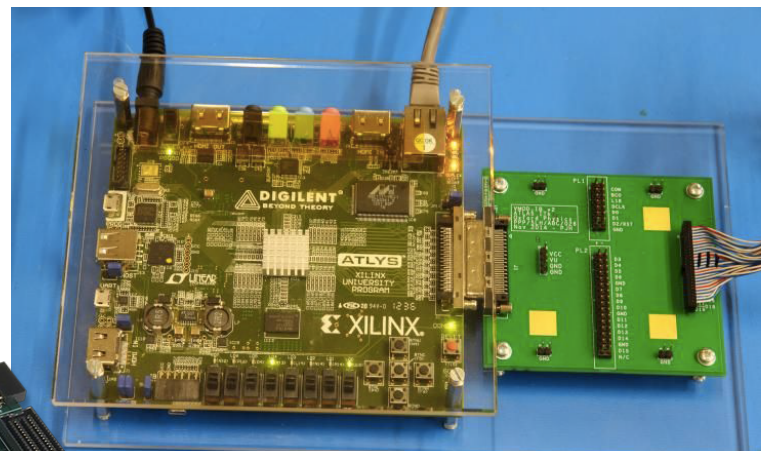
## HSIO:

- bulky
- mostly in disuse



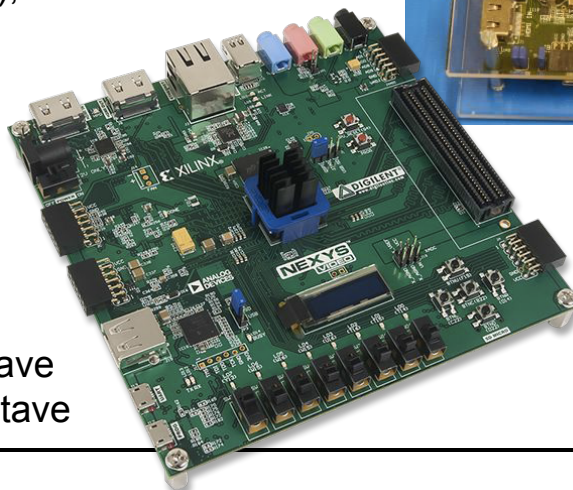
## ATLYS:

- compact
- still baseline for 2016 tests- No new versions issued – discontinued
- in use for both single ABC130 chip, ABC130+HCC chips (DAQ loads), testbeams etc.



## NEXYS:

- Next generation
- Evolution of ATLYS
- Cheap: ~\$500.
- Can readout 28 hybrids:
  - one side of a short-strip Stave
  - both sides of a long-strip Stave



# DAQ Firm/Software

## ITK strip DAQ

- ❑ Mostly an evolution of SCT DAQ
- ❑ Implements interfaces for Slow Control/DCS
- ❑ Main Firmware/Software developers in UK
- ❑ Many users around the world
  - Many different setup variations for different purposes: testbeam, irradiation studies, single chip tests, DAQ loads
  - Firmware/Software complexity reflects multitude of hardware setups
- ❑ Public Documentation is patchy, difficult to get started from scratch
  - <https://twiki.cern.ch/twiki/bin/viewauth/Atlas/StripsUpgradeDAQ>
  - Some from developers, some from users based on their specific setups
  - No thorough, centralised documentation for dummies yet

# DAQ Firm/Software

## ITK strip DAQ

### □ Developers Roadmap for this year

#### ➤ Firmware

- **Immediate (Q2 2016):**
  - Make sure Test Beam setups work
  - Fix bugs, focus on stability
  - Add only new features if needed
  - Hybrid Panel control/readout (8x Hybrid)
  - Rationalise f/w variations, common functionality across all hardware, same registers etc
  - TWiki tidy/update (!)
- **Then (Q3/4 2016)**
  - Electrical Eos Readout (with Nexys)
  - GBT: 1x with Nexys?, 4x with GLIB
  - Star chipset readout

#### ➤ Software

- Visual Studio 2015 works
- Linux is the ultimate goal
- Need to make Linux “nicer”
- A few developments in the list, e.g. migration to Root6 etc.

# DAQ Firm/Software

## ITK strip DAQ

### □ How to run it:

- Download appropriate firmware (web) and uploaded it to readout board (USB)
- Download ITSDAQ software (svn) install and build it
- Open Ethernet connection between PC and readout board
- Setup Configuration Files (see snippet below)

```
DETECTOR LV HV SLOG MuSTARD Module
id pr ac cr ch id ch id ck0 ck1 cm0 cm1 cm2 id s0 s1 d0 d1 Filename Device Type
-----
Module 0 1 1 0 0 -1 0 0 0 1 1 0 3 0 0 1 20 20 Module_1 ABCN_Test
Module 1 1 1 -1 0 -1 0 0 0 1 1 0 3 0 0 1 20 20 Module_2 ABCN_Test
....
```

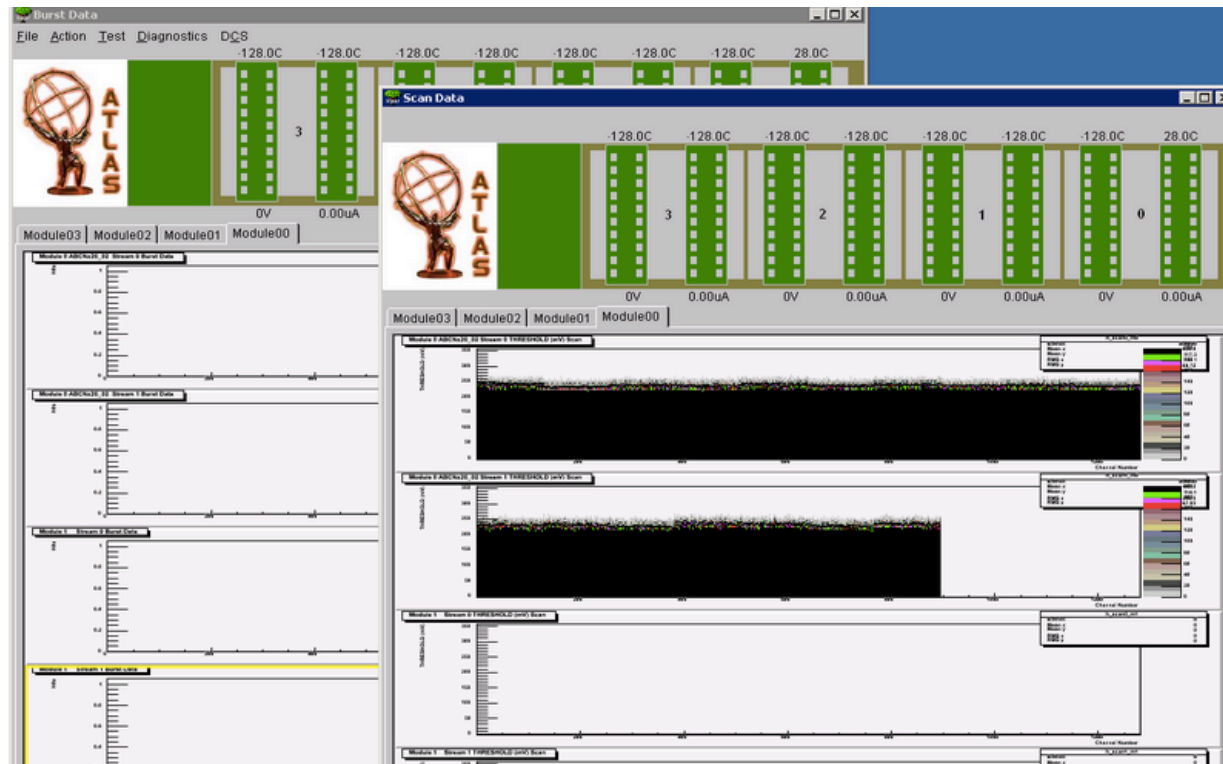
The majority of these variables were used for the old MUSTARD / VME based legacy DAQ and will be ignored for the HSIO.

```
Module : Link0 Link1 Oddity Chipset DTM SCmode bpm_dr vdac0 vdac1
        1      1    -1      6      1      0      3      512      512
        Select Vdet Idet Vcc Icc Vdd Idd Vil iVil Vled0 Iled0 Vled1 Iled1 Vpin Ramp
        0      200. 100. 3.5 1000. 4.0 600. 0. 10. 6. 10. 6. 10. 6. 2
Chip 0: Act. MasterB End Comp. Cal_m T_range Mask_r Edge Clock/2 Offset Cal+ Sig+ DownNotUp DriveU DriveD
        1      0      1      0      0      0      0      0      1      0      0      0      0      8      8
Bias : Shaper ShapFbck Preamp PreBuff PreFbck DiffBias CompBias
        9.4      9.82      139.4 9.4      0.3      31.44      31.44
Delay : Del. DelStep. Vth+ Vth- VCal LlDelay LlComm BISTPipe BISTRand
        23      2      25      0      50      128      1      0      0
```

# DAQ Firm/Software

## ITK strip DAQ

- Launch `> root -L stavelet.cpp`
- GUI will appear: from there you can run tests, diagnostics checks etc.



# DAQ Firm/Software

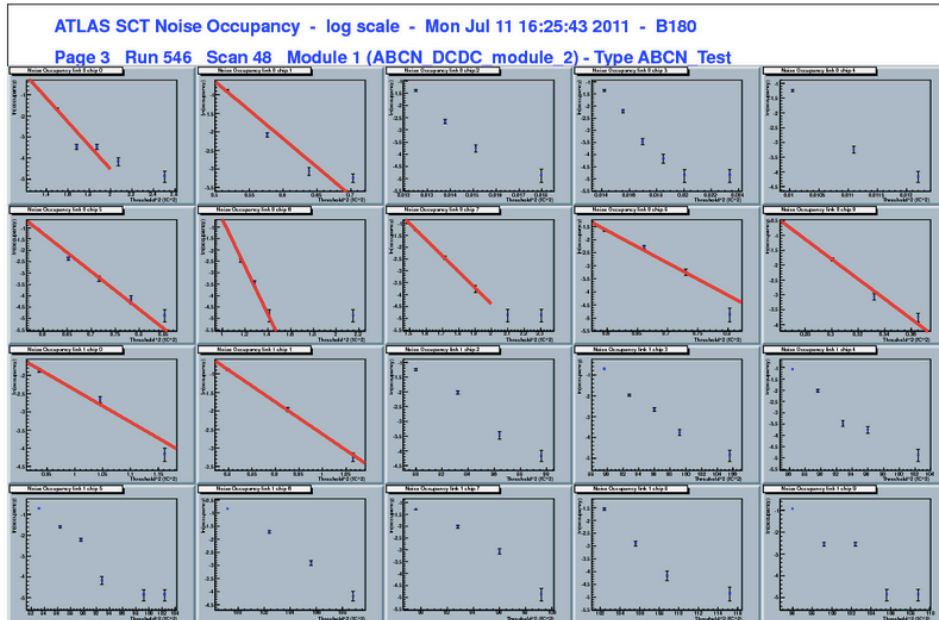
## ITK strip DAQ

### ❑ Test results for various tests

- StrobeDelay, NoiseOccupancy, ResponseCurve, 3PointGain etc.

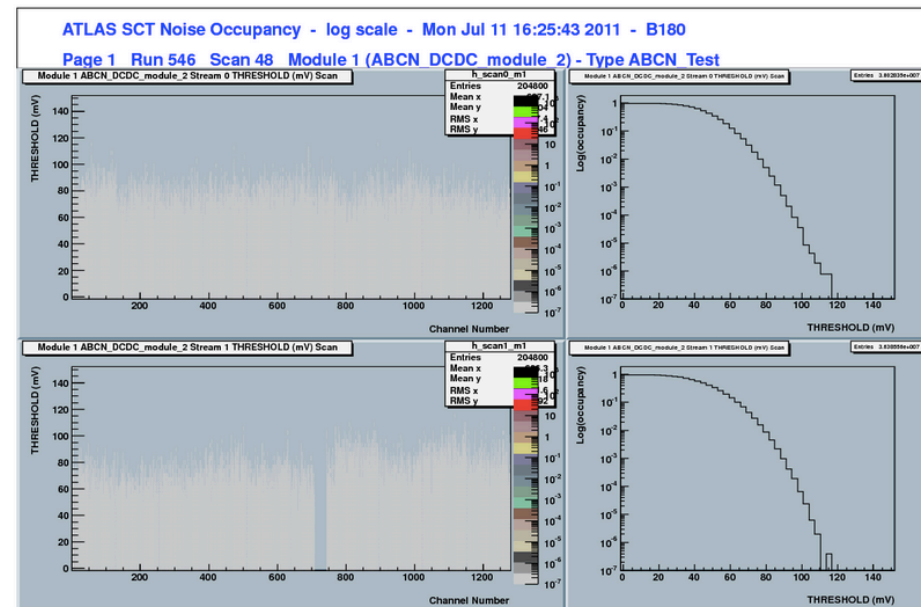
ATLAS SCT Noise Occupancy - log scale - Mon Jul 11 16:25:43 2011 - B180

Page 3 Run 546 Scan 48 Module 1 (ABCN DCDC module 2) - Type ABCN Test



ATLAS SCT Noise Occupancy - log scale - Mon Jul 11 16:25:43 2011 - B180

Page 1 Run 546 Scan 48 Module 1 (ABCN DCDC module 2) - Type ABCN Test



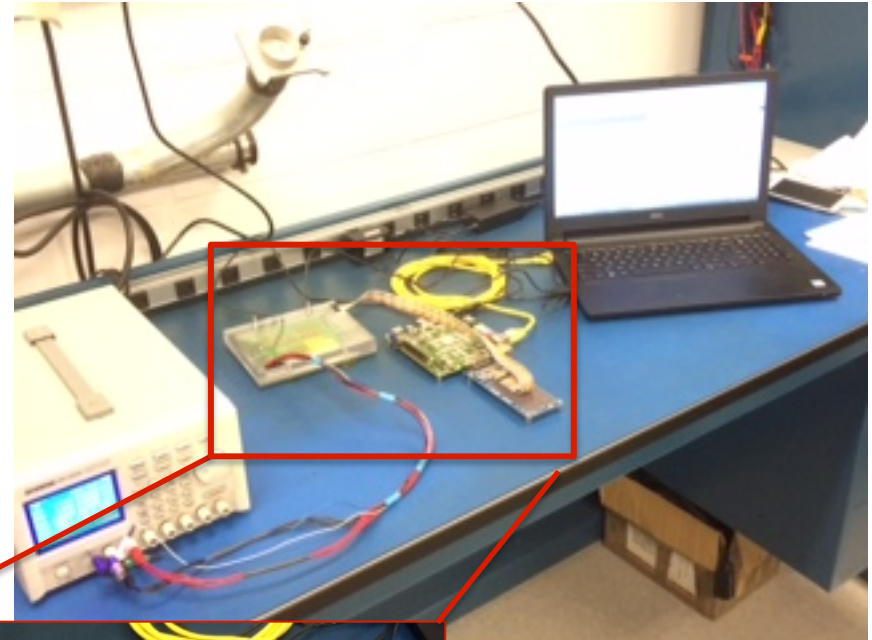


# DAQ Firm/Software

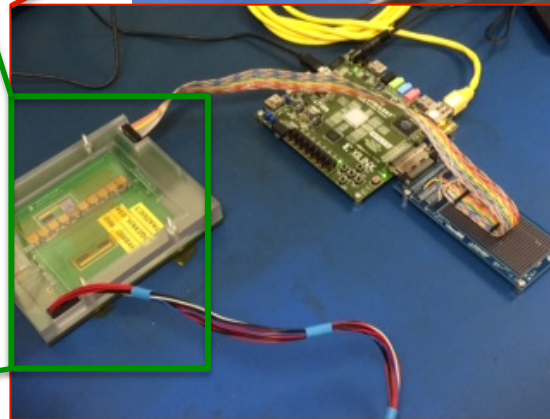
## ITK strip DAQ (ITSDaq)

### ❑ Setup at BNL

- Testing DAQ Load from RAL:
  - mini-sensor bonded to a hybrid with one ABC130 chip and one HCC chip
- ATLYS board
- Power-Supply
- Laptop with Linux Mint installation connected via ethernet to ATLYS



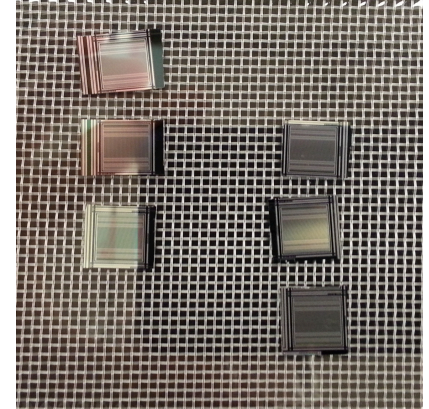
### Built at RAL



# DAQ Load Production at BNL

- ❑ BNL is assembling 7 DAQ Loads: 3 for US + 4 for UK Institutes
  - Mini-sensors from Santa Cruz
  - HCC fixes from LBNL and loaded in Santa Cruz
  - Hybrids from Liverpool
  - Module Frame produced at BNL
- ❑ First one has chips mounted and is being bonded, to be tested as soon as ready

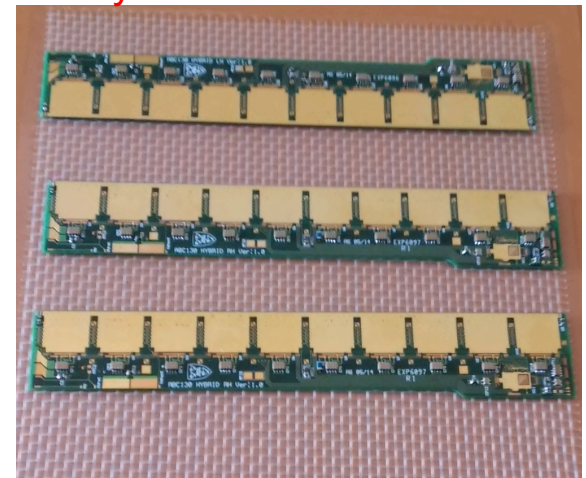
Mini-Sensors



Final product: DAQ load



Hybrids with HCC fixes



# Plans for Discussion

- ❑ Need to develop robust and simple system such that Students and PosDocs can run DAQ/DCS tests in production phase
  - a few Students and PostDocs expected from various Institutes in US with turn over
  
- ❑ Working model assumed for Module and Stave testing at BNL:
  - 1) 1 System for Hybrid burn-in on panels (in racks) - TBD
  - 2) 1 System for fast module reception tests for modules shipped from LBNL/UCSC
  - 3) 1 System for module burn-in for modules produced at BNL
  - 4) 1 System for testing assembled Staves
  - **Assuming 2 Staves assembled per week, i.e. 56 modules per week**
    - ~40 modules shipped from LBNL and UCSC need basic functionality tests at reception: ~1h per module
      - bunch a few (~5) modules together for testing in 1 cool box
    - ~20 modules built at BNL to burn-in for ~3 days
      - bunching a few (~10) modules together for testing

# Plans for Discussion

- ❑ Equipment needed for testing
  - Hybrid tests: need more thinking
  - Burn in of the 20 BNL modules (~3 days per set of ~10 modules)
    - **10 modules in 1 cool box**
      - = 1 cool box (freezer?) + 1 chiller
      - = 1 vacuum system + 1 dry air supply (nitrogen generator?)
      - = 10 cooling/vacuum chucks
      - = 10 LV-PS + 1 bias HV-PS + 10 PicoAm meters (communication via ITSDAQ s/w)
      - = 1 NEXYS board + 1 PC + Ethernet-GPIB
  - acceptance test of the 40 modules shipped to BNL (assume 5 modules simultaneously for 1h)
    - = 5 thermoelectric coolers + 5 vacuum chuck boxes
    - = 1 vacuum system + 1 dry air supply (nitrogen generator?)
    - = 5 LV-PS + 1 bias HV-PS + 5 PicoAm meters
    - = 1 NEXYS board + 1 PC + Ethernet-GPIB (communication via ITSDAQ s/w)
  - Stave testing
    - = 1 or more cool boxes, vacuum system, dry air supply
    - = PSs
    - = 2 NEXYS boards + 2 PC + Ethernet-GPIB

# Plans for Discussion

- ❑ Immediate plans at BNL (together with new PostDoc Stefania Stucci)
  - Look into DAQ software and learn how it works
  - Get it to work for DAQ Loads with our setup
  - Test DAQ Loads as they are produced
  - Write documentation!
  
- ❑ Goals:
  - Understand how code fits requirements of module/stave assembly sites
  - Help developers to make code more user-friendly and intuitive, and adapt it to our specific needs
  
- ❑ US ATLAS involvement in adaptation of ITK Strip DAQ for Module/Stave testing purposes?



# Backup



# Digilent Nexys Video

- ❑ Evolution of Atlys
- ❑ FMC connector
  - Widely used now
  - Also on GLIB etc.
  - We have some designs
    - Proto FMC -> VHDCI exists
- ❑ Also has PMOD connectors
  - 3x 4xLVDS pairs, 1x 8x SE
  - We have made PMODs
    - PMOD TTC and TLU interfaces
- ❑ ideas to split out the **VHCDI** connector through a special board to **HDMI** connections
- ❑ <https://reference.digilentinc.com/nexys-video:start>

